

## A POSITRON GENERATOR SYSTEM IN SUPPORT OF HIGH BRIGHTNESS MATERIALS CHARACTERIZATION AT THE PULSTAR REACTOR

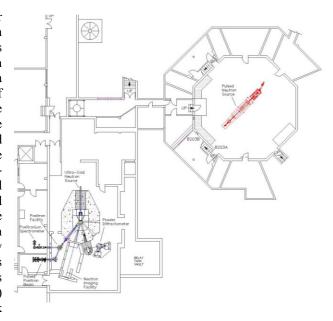
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**Program**: Minor Reactor Infrastructure

## **ABSTRACT:**

The objective of this project is to establish the capability for developing high brightness positron spectrometry at the North Carolina State University (NCSU) PULSTAR reactor. This capability will be based on a second generation platinum multi-stage positron converter/moderator that represents a natural evolution from the current system. The addition of this converter/moderator will significantly improve the performance of the intense positron beam facility at the PULSTAR and will allow the generation of an enhanced phase space (narrow energy and angular distribution) intense positron beam that can be used for high brightness (micronsized sample region of interest) applications. This will provide significant enhancement for the research and educational activities that are currently executed at the positron beam facility of the Nuclear Reactor Program (NRP). Specifically, a high brightness system will allow conducting innovative materials characterization experiments at the PULSTAR. It will also facilitate the use of this nondestructive examination technique in graduate (MS/PhD) studies and in undergraduate/graduate laboratory course work and projects.



The main components of the system are the platinum positron converter/moderator, the electrostatic beam focusing lenses and the magnetic beam guidance system. The operation of the system will start with gamma-rays and thermal neutrons emanating from the core of the PULSTAR reactor and end with an enhanced angular and energy distribution (phase space) intense positron beam that would enable high brightness positron spectrometry. The positrons produced by the platinum converter/moderator will be focused by a multi-stage electrostatic focusing system to a beam diameter less than 10 millimeters. The beam will be guided magnetically to the annihilation spectrometers. The infrastructure for electrostatic focusing and magnetic guidance already exists as part of the current beam system but will be modified to accommodate the geometry of the proposed converter/moderator. It is expected that the proposed system will yield a positron beam intensity of nearly 5.109 e+/s at reactor power of 1-MW and 1010 e+/s once the PULSTAR reactor power is upgraded to 2-MW. Consequently, high brightness performance becomes possible due to the beam's enhanced intensity and reliability, ideal phase space and reduced initial diameter.

Once operational, the facility will be available to users nationally and worldwide (similar to the PULSTAR reactor). Organization of access and scheduling will follow the procedures established at the NRP. Users will be directed to contact the NRP Nuclear Services department to discuss the potential application of interest to them. The facility will also be introduced to the DOE's NSUF system.

The cost of the proposed system is expected to be nearly \$200,000 with an additional \$50,000 in cost sharing that is provided by NCSU.